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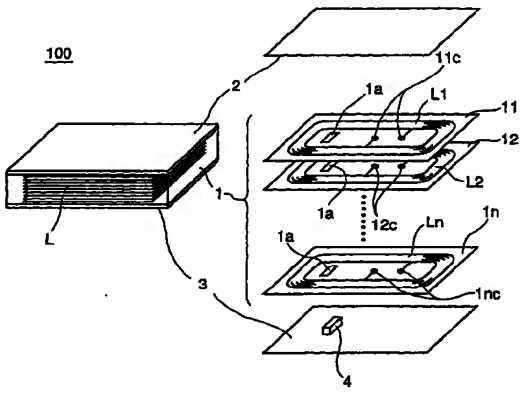
(54) SEMICONDUCTOR DEVICE AND METHOD FOR MANUFACTURING THE SAME

(57) A non-contact type IC card (100) includes a plurality of coil sheets (11,12, • • •, 1n). On a surface of each of coil sheets (11, 12, • • •, 1n), an electrically conductive layer (L1, L2, • • •, Ln) having a coil-like pattern is formed. An antenna coil (L) is formed by placing the plurality of coil sheets one on another. In a method of manufacturing the IC card (100), tape-like coil sheets (110, 120, 130, • • •) with the plurality of electrically conductive layers (L1) having coil-like patterns formed at a certain interval in a longitudinal direction and a plurality of feed holes (110b) formed at a certain interval in the longitudinal direction are employed. The tape-like coil sheets (110, 120, 130, • • •) are pulled out by a roller (31) having a protrusion fitting into the feed hole (110b).

Fig. 1



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Description

Technical Field

[0001] The present invention relates generally to a semiconductor device and a manufacturing method of the same, and more particularly to a structure of a non-contact type IC card having no power supply, converting radio waves received by a built-in antenna coil to power, utilizing it as a power supply and transmitting/receiving an electric signal to/from an external data processing device and a manufacturing method of the same.

Background Art

[0002] A non-contact type IC card has been proposed and has become available recently. The non-contact type IC card is provided with a semiconductor integrated circuit device (IC) for storing information (data) and receives/transmits information in a non-contact manner from/to an external data processing device that supplies or utilizes information. The non-contact type IC card can be applied as a carnet for ski lifts, a carnet or a season ticket for trains or buses, a tag for inventory control or the like. With the non-contact type IC cards, users do not need to pass the card through a card reader at a ticket barrier or the like as required. Only by carrying the card and passing near the data processing device such as a card examination device at the ticket barrier, confirmation and update of data can be achieved.

[0003] Fig. 4 shows an overall perspective view and an exploded perspective view of a non-contact type IC card as mentioned above (hereinafter referred to merely as "IC card").

[0004] As shown in Fig. 4, an IC card 500 includes two coil sheets 5 and 6, and a base member 7 placed therebetween. Base member 7 of a plastic material or the like, for example, is placed between two coil sheets 5 and 6 to secure a certain strength as an IC card. An electrically conductive layer L0 having a coil-like pattern is printed on a surface of each of coil sheets 5 and 6. Coil-like pattern electrically conductive layers L0 are connected to each other via a conduction member 8 such as a spring, thereby forming an antenna coil. Conduction member 8 is embedded in a conduction member hole 7b formed in base member 7. An electronic component 4 such as a microcomputer is placed and fit into a component mounting hole 7a formed in base member 7. Electronic component 4 is electrically connected to the antenna coil formed as described above.

[0005] Generally, the IC card with the above described structure does not include a built-in battery as a power supply. When the person or the object carrying the IC card passes near a data processing device such as a card examination device located at a ticket barrier in a skifield, the antenna coil receives radio waves sent from transmission means of the data processing device, then electronic component 4 detects the radio waves and a condenser is charged. Thus necessary power can be obtained. With the power thus obtained, a semiconductor device such as a microcomputer embedded in electronic component 4 can be driven and data on fee or the like can be rewritten. The status of use of the IC card can be confirmed through the data processing device by sending the rewritten data to the external data processing device. Therefore it is possible to pass and guide only the entitled persons and objects to a given direction.

[0006] As the data confirmation can be achieved through bi-directional transmission using radio waves in a non-contact manner, the user does not need to take the card out and insert the card into the data processing device every time he/she passes the ticket barrier or the like. Therefore the user can pass the ticket barrier faster and the congestion can be relaxed. The convenience of the IC card as described above makes it a prospective product for applications in various areas such as motorway fee confirmation.

[0007] The above described conventional IC card, however, has the following problems in terms of performance, cost, and productivity.

[0008] With respect to its performance, as the antenna coil is constituted only of two electrically conductive layers, that is, coil-like electrically conductive layers L0 printed on the surfaces of coil sheets 5 and 6, electromagnetic induction is weak and only a little power is obtained. Therefore, charge of sufficient power required for data processing such as data transmission takes a long time.

[0009] Second, with respect to its cost, in the antenna coil structure, base member 7 and conduction member 8 are necessary besides coil sheets 5 and 6. This raises the manufacturing cost.

[0010] Further, with respect to productivity, a step of mounting conduction member 8 is required and hinders improvement in productivity.

[0011] Still further, a problem in its appearance exists. As conduction member 8 such as a spring is employed for the electrical connection of two coil-like electrically conductive layers L0, a finished IC card product inevitably has an uneven surface.

[0012] Hence, an object of the present invention is to solve the above mentioned problems and to provide a semiconductor device, particularly an IC card, with high performance, low cost, and high productivity, and a manufacturing method thereof.

Disclosure of the Invention

[0013] A semiconductor device according to the present invention includes a first coil sheet with a first electrically conductive layer having a coil-like pattern formed thereon, and a second coil sheet with a second electrically conductive layer having a coil-like pattern formed thereon, placed on said first coil sheet.

[0014] Preferably the first coil sheet has a front surface and a back surface, the first electrically conductive layer is formed on the front surface, the second coil sheet has a front surface and a back surface, the second electrically conductive layer is formed on the front surface, and the back surface of the second coil sheet is placed on the front surface of the first coil sheet.

[0015] In addition, preferably the front surface of the first coil sheet is glued to the back surface of the second coil sheet.

[0016] Further preferably, a first through hole electrically connected to the first electrically conductive layer is formed on the front surface of the first coil sheet and a second through hole electrically connected to the second electrically conductive layer is formed on the front surface of the second coil sheet. Here, the first electrically conductive layer and the second electrically conductive layer are electrically connected via the first through hole and the second through hole when the first coil sheet and the second coil sheet are placed one on another.

[0017] The first electrically conductive layer and the second electrically conductive layer electrically connected to each other as described above form an antenna coil.

[0018] Preferably the semiconductor device according to the present invention is an IC card converting radio waves received by the antenna coil formed as described above to power, utilizing the power as a power supply and transmitting/receiving an electric signal to/from an external data processing device.

[0019] In the semiconductor device according to the present invention, preferably, penetration holes communicating to each other when the first coil sheet and the second coil sheet are placed one on another are formed in the first coil sheet and the second coil sheet.

[0020] The semiconductor device according to the present invention preferably further includes an electronic component provided in the penetration hole.

[0021] In addition in the semiconductor device according to the present invention, preferably, the first electrically conductive layer and the second electrically conductive layer are printed on the first coil sheet and the second coil sheet, respectively.

[0022] The semiconductor device according to the present invention preferably further includes an upper sheet and a lower sheet respectively provided on and below the first coil sheet and the second coil sheet placed one on another so as to sandwich and cover the first coil sheet and the second coil sheet.

[0023] In the semiconductor device according to the present invention preferably the first coil sheet and the second coil sheet are glued to each other by adhesive.

[0024] In the semiconductor device such as an IC card with the structure as described above, as an antenna coil is formed by placing a plurality of coil sheets with coil-like pattern electrically conductive layers formed thereon one on another, a stronger electromagnetic induction is generated. Therefore, predetermined power required for data processing such as data transmission to/from the external data processing device, or data rewriting, can be obtained in a shorter time period.

[0025] In addition, in the semiconductor device of the present invention, a base member and a conduction member such as a spring are not necessary to electrically connect coil-like pattern electrically conductive layers to each other. Thus, the manufacturing steps can be simplified because the step of mounting a member other than the coil sheet is not required.

[0026] In addition, as the use of conduction member such as a spring is not necessary for electrically connecting coil-like pattern electrically conductive layers, no ups and downs are produced on the surface of the finished semiconductor device.

[0027] Thus in the semiconductor device such as an IC card according to the present invention, the same amount of power can be obtained in a shorter time period than in the conventional device. As a result, the distance required for obtaining the power necessary for data transmission, data processing or the like, that is the distance for the IC card to pass the external data processing device can be decreased. In addition, with the simplification of the manufacturing steps as described above, reduced manufacturing cost and the increased productivity can both be attained. Further, the ups and downs on the surface of the IC card can be reduced.

[0028] A manufacturing method of the semiconductor device according to the present invention includes the following steps.

(a) Step of preparing a first tape-like coil sheet and a second tape-like coil sheet each having a plurality of electrically conductive layers having coil-like patterns formed at a certain interval in a longitudinal direction and having a plurality of feed holes formed at a certain interval in the longitudinal direction.

(b) Step of pulling out the first tape-like coil sheet and the second tape-like coil sheet by a roller having a protrusion fitting into the feed hole so as to place the second tape-like coil sheet on the first tape-like coil sheet.

(c) Step of placing the first tape-like coil sheet on the second tape-like coil sheet pulled out at the step of pulling out.

[0029] The preferable method of manufacturing the semiconductor device according to the present invention further includes the step of forming an electronic component mounting hole penetrating the first tape-like coil sheet and the second tape-like coil sheet placed one on another. Here, the method of manufacturing the semiconductor device preferably further includes the step of providing an electronic component in the electronic component mounting hole.

[0030] Still further, the preferable method of manufac-

turing the semiconductor device according to the present invention further includes the step of placing a tape-like upper sheet and a tape-like lower sheet on and below the first tape-like coil sheet and the second tape-like coil sheet placed one on another so as to sandwich and cover the first tape-like coil sheet and the second tape-like coil sheet.

[0031] The preferable method of manufacturing the semiconductor device according to the present invention further includes the step of pulling out a portion of the first coil sheet and the second coil sheet placed one on another each including the coil-like pattern electrically conductive layer from the first tape-like coil sheet and the second tape-like coil sheet placed one on another.

[0032] The preferable method of manufacturing the semiconductor device according to the present invention further includes the step of applying adhesive on front surfaces of the first tape-like coil sheet and the second tape-like coil sheet prior to the step of pulling out the first tape-like coil sheet and the second tape-like coil sheet.

[0033] In the manufacturing method of the semiconductor device according to the present invention characterized as described above, a plurality of feed holes are formed on the tape-like coil sheet at a certain interval in a longitudinal direction as well as a plurality of coil-like pattern electrically conductive layers. Therefore, when tape-like coil sheets are placed one on another, tape-like coil sheets can be easily and securely aligned by a roller having a protrusion fitting in the feed hole. Thus, successive manufacturing of the semiconductor device such as the IC card is possible, whereby the mass production is allowed. Hence, the manufacturing cost of the semiconductor device can be reduced.

Brief Description of the Drawings

[0034]

Fig. 1 shows an overall perspective view and an exploded perspective view showing a schematic structure of an IC card according to one embodiment of the present invention.

Fig. 2 is a diagram schematically showing steps and being referenced for describing an example of a manufacturing method of the IC card according to one embodiment of the present invention.

Fig. 3A is a top view and Fig. 3B is a side view of a tape-like coil sheet employed in one example of the manufacturing method of the IC card of the present invention.

Fig. 4 shows an overall perspective view and an exploded perspective view showing a schematic structure of a conventional IC card.

Best Modes for Carrying Out the Invention

[0035] Hereinafter, one embodiment of the present invention will be described with reference to the drawings.

[0036] As shown in Fig. 1, an IC card 100 which is a semiconductor device according to one embodiment of the present invention includes an antenna portion 1, and an upper sheet 2 and a lower sheet 3 located on and below antenna portion 1 such that they sandwich and cover antenna portion 1. Antenna portion 1 is constituted of a plurality of coil sheets 11, 12, • • • 1n of synthetic resin placed one on another and having a thickness about a few hundred μm. Coil-like pattern electrically conductive layers L1, L2, • • •, Ln are printed and formed on surfaces of coil sheets 11,12, • • •, 1n, respectively by photolithography or the like. In addition, through holes 11c, 12c, • • •, 1nc are formed on surfaces of coil sheets 11, 12, • • •, 1n, respectively by photolithography or the like. Through holes 11c, 12c, • • •, 1nc are electrically connected to coil-like electrically conductive layers L1, L2, • • •, Ln, respectively through predetermined interconnection patterns. Coil-like electrically conductive layers L1, L2, • • •, Ln of coil sheets 11, 12, • • •, 1n are connected to col-like electrically conductive layers of adjacent coil sheets via through holes 11c, 12c, • • •, 1nc, respectively by multilayer interconnection technique employing an electrically conductive metal paste such as silver paste, thereby forming one antenna coil L.

[0037] In addition, a component mounting hole 1a is formed in each coil sheet in antenna portion 1. Component mounting holes 1a communicate with each other when coil sheets 11, 12, • • •, 1n are placed one on another. Electronic component 4 is mounted in component mounting hole 1a. Surfaces of antenna portion 1 are covered with upper sheet 2 and lower sheet 3 of the same material as the coil sheet.

[0038] Electronic component 4 is constituted of a microcomputer, a condenser, and so on for detecting radio waves transmitted from a source external to the IC card, obtaining the power and data, and transmitting data. Electronic component 4 is mounted on lower sheet 3 directly by a so-called COB (Chip On Board) technique or via a substrate by TAB (Tape Automated Bonding) technique. Further, electronic component 4 is electrically connected to an antenna coil L of antenna portion 1 via a wire bonding or a soldering bump formed in a pad.

[0039] As described above, in the IC card according to one embodiment of the present invention, antenna coil L is formed from coil-like electrically conductive layers L1, L2, • • •, Ln, respectively printed on a plurality of coil sheets 11, 12, • • • , 1n, and whereby antenna portion 1 is formed. Therefore, the number of coil winds is larger than that in a conventional IC card, whereby a stronger electromagnetic induction can be generated.

[0040] In addition, antenna portion 1 has a relatively

large strength and flexibility as the structure thereof includes a plurality of coil sheets. Hence, antenna portion 1 serves as the base member in the conventional IC card. In addition, coil-like electrically conductive layers L1, L2, • • •, Ln of coil sheets 11, 12, • • •, 1n are directly and electrically connected to each other via through holes formed in adjacent coil sheets. Therefore, in the IC card of the present invention, the base member and the conduction member such as a spring required in the conventional IC card are not necessary.

[0041] If an even stronger electromagnetic induction is needed in the IC card of the embodiment described above, coil sheets can be employed in place of upper sheet 2 and lower sheet 3.

[0042] Next, an example of the manufacturing method of the IC card of the present invention will be described with reference to Figs. 2, 3A and 3B.

[0043] As shown in Fig. 2, first, rolls of tape-like coil sheets 110, 120 and 130 are prepared. Figs. 3A and 3B show a structure of tape-like coil sheet 110 as an example of each tape-like coil sheet. As shown in Figs. 3A and 3B, coil-like electrically conductive layers L1 are formed successively at a certain interval in a longitudinal direction on the surface of tape-like coil sheet 110. In addition, a through hole 110c is formed at an end of an interconnection pattern electrically connected to coil-like electrically conductive layer L1. Coil-like electrically conductive layer L1 and through hole 110c are successively printed on the surface of tape-like coil sheet 110 by photolithography. At either sides of coil-like electrically conductive layer L1, a plurality of feed holes 110b are formed at a certain interval in the longitudinal direction. Feed hole 110b is utilized for the alignment of tape-like coil sheet 110 and for feeding tape-like coil sheet 110 to the next step.

[0044] Similar to tape-like coil sheet 110 shown in Figs. 3A and 3B, a tape-like upper sheet 20 and a tape-like lower sheet 30 shown in Fig. 2 have feed holes corresponding to feed holes 110b and formed as rolls.

[0045] As shown in Fig. 2, a plurality of, preferably three to five, roll-like wound tape-like coil sheets 110, 120, 130, • • • are pulled out and adhesive is applied on surfaces thereof by adhesive applying rollers 41, 42, 43, • • •. Thereafter, a roller 31 having a protrusion fitting into feed hole 110b (see Fig. 3A) of tape-like coil sheets 110, 120, 130, • • • pulls out tape-like coil sheets 110, 120, 130, • • •. Then, tape-like coil sheets 110, 120, 130, • • • are pressed and attached to each other by a pressure roller 32, whereby antenna portion 1 (see Fig. 1) is formed.

[0046] Next, antenna portion 1 is held by a gripping device 33 at upper and lower surfaces and punched by a punching device 34. Thus, a first punched portion 110a shown by a dotted line in Figs. 3A and 3B is punched through. Component mounting hole 1a (see Fig. 1) is thus formed in antenna portion 1.

[0047] Antenna portion 1 and tape-like lower sheet 30 wound like a roll are pulled out by a roller 35 having a protrusion fitting into the feed hole, and electronic component 4 is mounted thereon at a support base 36.

[0048] Further, together with antenna portion 1 and tape-like lower sheet 30, tape-like upper sheet 20 wound like a roll is pulled out by a roller 37 having a protrusion fitting into each feed hole of the tape-like coil sheet, the tape-like upper sheet and the tape-like lower sheet, and then a pressure roller 38 presses and attaches them to each other.

[0049] Then the successively formed tape-like IC card is held at its upper surface and lower surface by a gripping device 39 and punched by a punching device 40. Thus, a second punched portion 110d shown by a dotted line in Figs. 3A and 3B are punched through, whereby a separate IC card 100 (see Fig. 1) is obtained.

[0050] In addition, a step of forming component mounting hole 1a in antenna portion 1 can be eliminated by using sheets with component mounting hole 1a previously formed thereon as tape-like coil sheets 110, 120, 130, • • •. Although in the embodiment described above, electronic component 4 is arranged inside coil-like electrically conductive layers L1, L2, • • •, Ln, electronic component can be arranged outside the coil-like electrically conductive layer. The number of tape-like coil sheets placed one on another can be optionally set according to the thickness of designed IC card 100 and the amount of power required for data transmission, data processing, and so on. In addition, tape-like coil sheets 110, 120, 130, • • • may be glued to each other by fusion according to the humidity in atmosphere.

[0051] In the manufacturing method of the IC card described above, at the manufacture of the IC card of the present invention, the alignment of the plurality of coil sheets 11, 12, • • •, 1n to be placed one on another and the alignment of antenna portion 1 and upper and lower sheets 2 and 3 can be easily and securely performed and successive manufacturing is allowed.

Industrial Applicability

[0052] The semiconductor device according to the present invention can be applied as a non-contact type IC card, such as a carnet of ski lift, carnets and season tickets of trains and buses, or a tag for inventory control, allowing data confirmation and update without making contact with the external data processing device.

Claims

1. A semiconductor device comprising:

   a first coil sheet (12) with a first electrically conductive layer (L2) having a coil-like pattern formed thereon; and
   a second coil sheet (11) with a second electrically conductive layer (L1) having a coil-like pattern formed thereon, placed on said first coil

sheet (12).

2. The semiconductor deuce according to claim 1, wherein

said first soil sheet (12) has a front surface and a back surface, and said first electrically conductive layer (L2) is formed on the front surface,
said second coil sheet (11) has a front surface and a back surface, and said second electrically conductive layer (L1) is formed on the front surface, and
the back surface of said second coil sheet (11) is placed on the front surface of said first coil sheet (12).

3. The semiconductor device according to claim 2, wherein

the front surface of said first coil sheet (12) is glued to the back surface of said second coil sheet (11).

4. The semiconductor device according to claim 2, wherein

a first through hole (12c) electrically connected to said first electrically conductive layer (L2) is formed on the front surface of said first coil sheet (12) and a second through hole (11c) electrically connected to said second electrically conductive layer (L1) is formed on the front surface of said second coil sheet (11), and said first electrically conductive layer (L2) and said second electrically conductive layer (L1) are electrically connected via said first through hole (12c) and said second through hole (11c) when said first coil sheet (12) and said second coil sheet (11) are placed one on another.

5. The semiconductor device according to claim 4, wherein

an antenna coil (L) is formed by said first electrically conductive layer (L2) and said second electrically conductive layer (L1) electrically connected to each other.

6. The semiconductor device according to claim 5, wherein

the semiconductor device is an IC card (100) converting radio waves received by said antenna coil (L) to power, utilizing the power as a power supply and transmitting/receiving an electric signal to/from an external data processing device.

7. The semiconductor device according to claim 1, wherein

penetration holes (1a) communicating to each other when said first coil sheet (12) and said second coil sheet (11) are placed one on another are formed in said first coil sheet (12) and said second coil sheet (11), respectively.

8. The semiconductor device according to claim 7 further comprising an electronic component (4) provided in said penetration hole (1a).

9. The semiconductor device according to claim 1 wherein

said first electrically conductive layer (L2) and said second electrically conductive layer (L1) are printed on said first coil sheet (12) and said second coil sheet (11), respectively.

10. The semiconductor device according to claim 1 further comprising an upper sheet (2) and a lower sheet (3) respectively provided on and below said first coil sheet (12) and said second coil sheet (11) placed one on another so as to sandwich and cover said first coil sheet (12) and said second coil sheet (11).

11. The semiconductor device according to claim 1 wherein said first coil sheet (12) and said second coil sheet (11) are glued to each other by adhesive.

12. A method of manufacturing a semiconductor device comprising the steps of:

preparing a first tape-like coil sheet (110) and a second tape-like coil sheet (120) each having a plurality of electrically conductive layers (L1) having coil-like patterns formed at a certain interval in a longitudinal direction and having a plurality of feed holes (110b) formed at a certain interval in the longitudinal direction;
pulling out said first tape-like coil sheet (110) and said second tape-like coil sheet (120) by a roller (31) having a protrusion fitting into said feed hole (110b) so as to place said second tape-like coil sheet (120) on said first tape-like coil sheet (110); and
placing said first tape-like coil sheet (110) on said second tape-like coil sheet (120) pulled out at the step of pulling out.

13. The method of manufacturing the semiconductor device according to claim 12 further comprising the step of forming an electronic component mounting hole (110a) penetrating said first tape-like coil sheet (110) and said second tape-like coil sheet (120)

placed one on another.

14. The method of manufacturing the semiconductor device according to claim 13 further comprising the step of providing an electronic component (4) in said electronic component mounting hole (110a).

15. The method of manufacturing the semiconductor device according to claim 12 further comprising the step of placing a tape-like upper sheet (20) and a tape-like lower sheet (30) respectively on and below said first tape-like coil sheet (110) and said second tape-like coil sheet (120) placed one on another so as to sandwich and cover said first tape-like coil sheet (110) and said second tape-like coil sheet (120).

16. The method of manufacturing the semiconductor device according to claim 12 further comprising the step of pulling out a portion of the first coil sheet and the second coil sheet placed one on another each including said coil-like pattern electrically conductive layer (L1), from said first tape-like coil sheet (110) and said second tape-like coil sheet (120) placed one on another.

17. The method of manufacturing the semiconductor device according to claim 12 further comprising the step of applying adhesive on front surfaces of said first tape-like coil sheet (110) and said second tape-like coil sheet (120) prior to the step of pulling out said first tape-like coil sheet (110) and said second tape-like coil sheet (120).

Amended claims under Art. 19.1 PCT

1. (Amended) An IC card device comprising:

a first coil sheet (12) having a penetration hole (1a) formed so as to surround an electronic component (4) and a first electrically conductive layer (L2) having a coil-like pattern formed so as to surround the penetration hole; and
a second coil sheet (11) having a penetration hole (1a) formed so as to surround the electronic component (4) and a second electrically conductive layer (L1) having a coil-like pattern formed so as to surround the penetration hole, and placed on said first coil sheet (12).

2. (Amended) The IC card device according to claim 1, wherein

said first coil sheet (12) has a front surface and a back surface, and said first electrically conductive layer (L2) is formed on the front surface,
said second coil sheet (11) has a front surface and a back surface, and said second electrically conductive layer (L1) is formed on the front surface, and
the back surface of said second coil sheet (11) is placed on the front surface of said first coil sheet (12).

3. (Amended) The IC card device according to claim 2, wherein the front surface of said first coil sheet (12) is glued to the back surface of said second coil sheet (11).

4. (Amended) The IC card device according to claim 2, wherein

a first through hole (12c) electrically connected to said first electrically conductive layer (L2) is formed on the front surface of said first coil sheet (12) and a second through hole (11c) electrically connected to said second electrically conductive layer (L1) is formed on the front surface of said second coil sheet (11), and said first electrically conductive layer (L2) and said second electrically conductive layer (L1) are electrically connected via said first through hole (12c) and said second through hole (11c) when said first coil sheet (12) and said second coil sheet (11) are placed one on another.

5. (Amended) The IC card device according to claim 4, wherein an antenna coil (L) is formed by said first electrically conductive layer (L2) and said second electrically conductive layer (L1) electrically connected to each other.

6. (Amended) The IC card device according to claim 5, wherein the semiconductor device is an IC card (100) converting radio waves received by said antenna coil (L) to power, utilizing the power as a power supply and transmitting/receiving an electric signal to/from an external data processing device.

7. (Amended) The IC card device according to claim 1, wherein penetration holes (1a) communicating to each other when said first coil sheet (12) and said second coil sheet (11) are placed one on another are formed in said first coil sheet (12) and said second coil sheet (11), respectively.

8. (Amended) The IC card device according to claim 7 further comprising an electronic component (4) provided in said penetration hole (1a).

9. (Amended) The IC card device according to claim 1 wherein said first electrically conductive layer (L2) and said second electrically conductive layer (L1) are printed on said first coil sheet (12) and said second coil sheet (11), respectively.

10. (Amended) The IC card device according to claim 1 further comprising an upper sheet (2) and a lower sheet (3) respectively provided on and below said first coil sheet (12) and said second coil sheet (11) placed one on another so as to sandwich and cover said first coil sheet (12) and said second coil sheet (11).

11. (Amended) The IC card device according to claim 1 wherein said first coil sheet (12) and said second coil sheet (11) are glued to each other by adhesive.

12. (Amended) A method of manufacturing an IC card device comprising the steps of:

preparing a first tape-like coil sheet (110) and a second tape-like coil sheet (120) each having a plurality of electrically conductive layers (L1) having coil-like patterns formed at a certain interval in a longitudinal direction and having a plurality of feed holes (110b) formed at a certain interval in the longitudinal direction;
pulling out said first tape-like coil sheet (110) and said second tape-like coil sheet (120) by a roller (31) having a protrusion fitting into said feed hole (110b) so as to place said second tape-like coil sheet (120) on said first tape-like coil sheet (110); and
placing said first tape-like coil sheet (110) on said second tape-like coil sheet (120) pulled out at the step of pulling out.

13. (Amended) The method of manufacturing the IC card device according to claim 12 further comprising the step of forming an electronic component mounting hole (110a) penetrating said first tape-like coil sheet (110) and said second tape-like coil sheet (120) placed one on another.

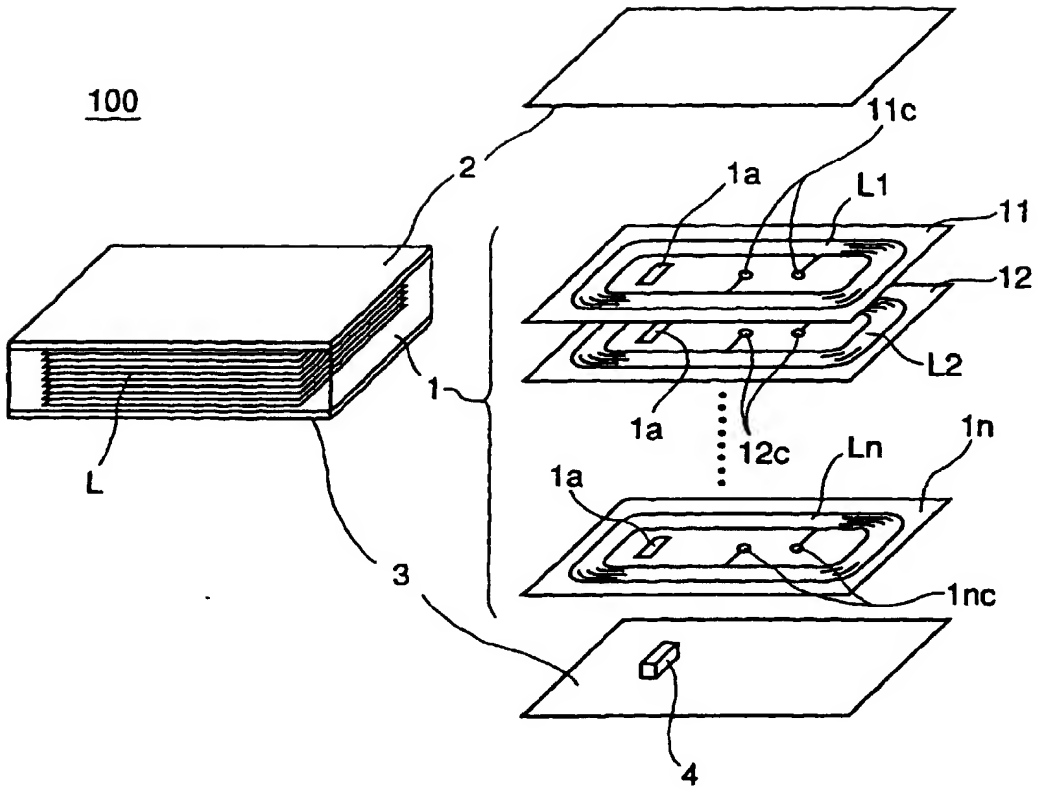
14. (Amended) The method of manufacturing the IC card device according to claim 13 further comprising the step of providing an electronic component (4) in said electronic component mounting hole (110a).

15. (Amended) The method of manufacturing the IC card device according to claim 12 further comprising the step of placing a tape-like upper sheet (20) and a tape-like lower sheet (30) respectively on and below said first tape-like coil sheet (110) and said second tape-like coil sheet (120) placed one on another so as to sandwich and cover said first tape-like coil sheet (110) and said second tape-like coil sheet (120).

16. (Amended) The method of manufacturing the IC card device according to claim 12 further comprising the step of pulling out a portion of the first coil sheet and the second coil sheet placed one on another each including said coil-like pattern electrically conductive layer (L1), from said first tape-like coil sheet (110) and said second tape-like coil sheet (120) placed one on another.

17. (Amended) The method of manufacturing the IC card device according to claim 12 further comprising the step of applying adhesive on front surfaces of said first tape-like coil sheet (110) and said second tape-like coil sheet (120) prior to the step of pulling out said first tape-like coil sheet (110) and said second tape-like coil sheet (120).

Fig.1



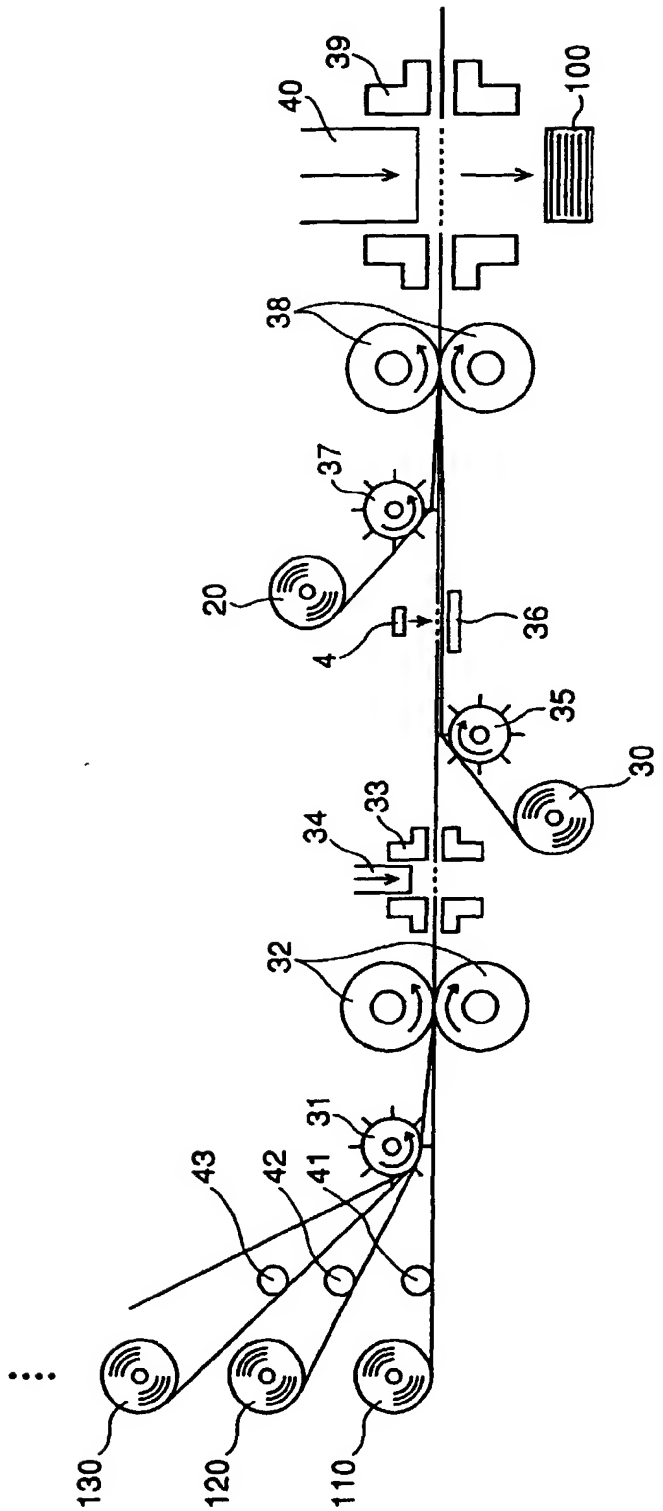


Fig.2

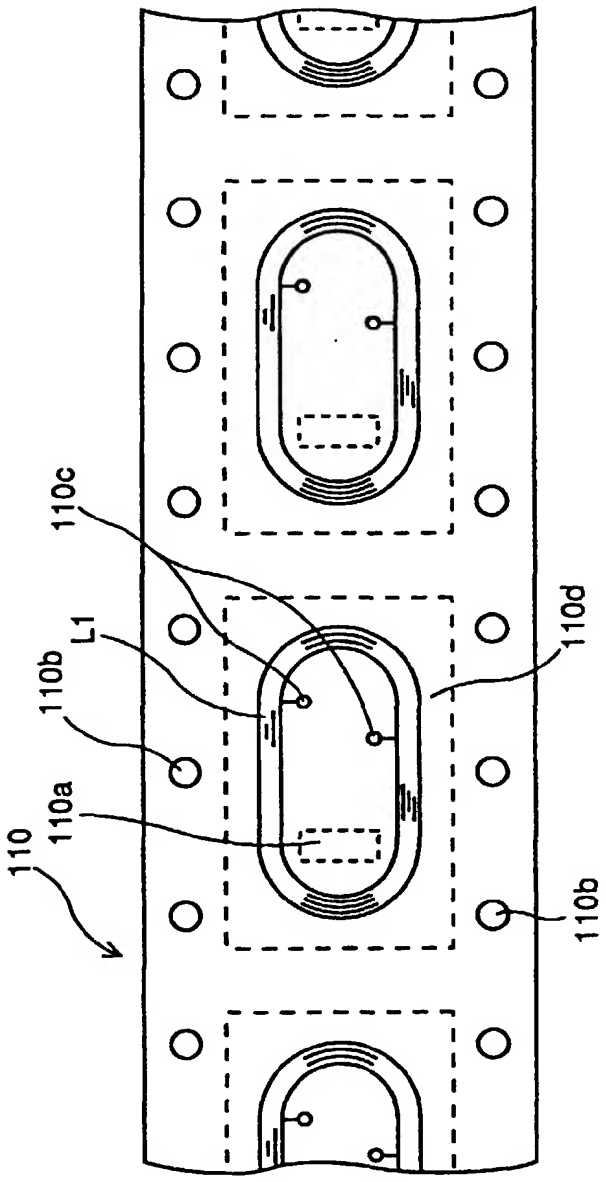


Fig.3A

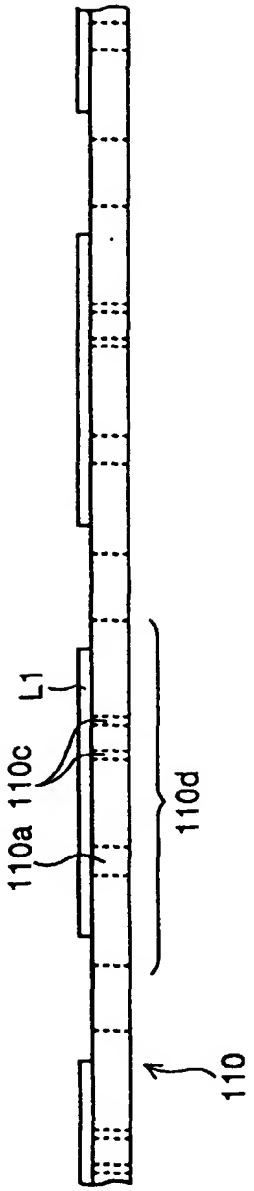
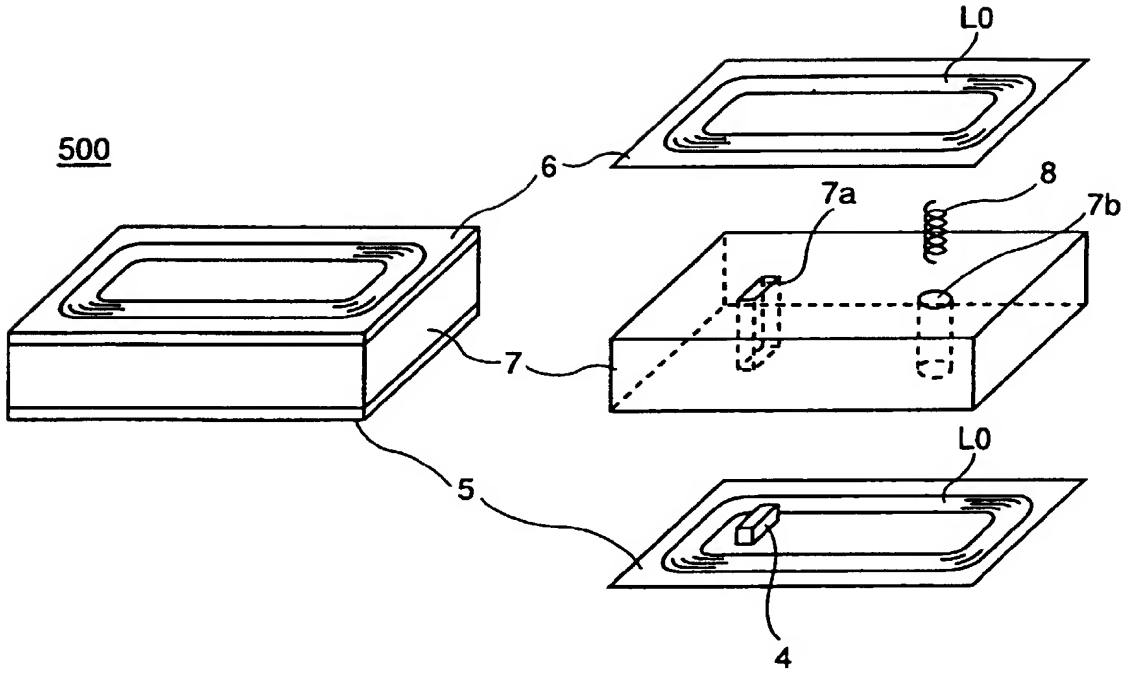


Fig.3B

Fig.4



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP97/04503

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[6] B42D15/10, G06K19/07

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[6] B42D15/10, G06K19/07

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Toroku Jitsuyo Shinan Koho 1994-1998
Kokai Jitsuyo Shinan Koho 1971-1998 Jitsuyo Shinan Toroku Koho 1996-1998

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP, 8-216570, A (Hitachi Chemical Co., Ltd.), August 27, 1996 (27. 08. 96), Full text ; Figs. 1 to 5 Full text ; Figs. 1 to 5 (Family: none)	1-5, 7-11 6, 12-17
Y	JP, 5-54209, A (Arimura Giken K.K.), March 5, 1993 (05. 03. 93), Page 3, left column, lines 12 to 28 (Family: none)	6
Y	JP, 62-41096, A (Toppan Moore Co., Ltd.), February 23, 1987 (23. 02. 87), Full text ; Figs. 1 to 4 (Family: none)	12-17
Y	JP, 6-336096, A (Omron Corp.), December 6, 1994 (06. 12. 94), Full text ; Figs. 1 to 6 (Family: none)	1-11
P, Y	JP, 9-286188, A (Matsushita Electric Works, Ltd.), November 4, 1997 (04. 11. 97), Page 5, right column, lines 24 to 41 ; Fig. 9 (Family: none)	1-11

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"P" document published prior to the international filing date but later than the priority date claimed
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
March 2, 1998 (02. 03. 98)	March 17, 1998 (17. 03. 98)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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